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भाग 1 सामान्य एवं सुरक्षा अपेक्षाएं

Indian Standard

ac SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS – SPECIFICATION

PART 1 GENERAL AND SAFETY REQUIREMENTS

(First Reprint NOVEMBER 1992)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1991 **Price Group 5**

Electric Lamps and Their Auxiliaries Sectional Committee, ETD 23

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and Their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers general and safety requirements for ac supplied electronic ballasts for tubular fluorescent lamps generally operating with a frequencey deviating from the supply frequency. Performance requirements are covered in Part 2 of this standard.

> NOTE — Safety requirements ensure that electric equipment having been constructed in accordance with these requirements, does not endanger the safety of persons, domestic animals or property, when properly installed and maintained and used in applications for which it is made.

Requirements for supply current waveform regarding all types of ballasts are presently being considered. Pending the outcome of these considerations, such requirements are not yet specified. This standard refers to ac supplied electronic ballasts for use with tubular fluorescent lamps as specified in IS 2418 (Part 2) : 1977 'Specification for tubular fluorescent lamps for general lighting service : Part 2 Standard lamp data sheets (*first revision*)', and other lamps for high frequency operation.

In the preparation of this standard, assistance has been taken from IEC Publication 928 : 1990 'AC supplied electronic ballasts for tubular fluorescent lamps : General and safety requirements', issued by the International Electrotechnical Commission (IEC).

Indian Standard

ac SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS — SPECIFICATION

PART 1 GENERAL AND SAFETY REQUIREMENTS

1 SCOPE

1.1 This standard (Part 1) specifies general and safety requirements for electronic ballasts for use on ac supplies up to 1 000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency associated with tubular fluorescent lamps as specified in IS 2418 (Part 2) : 1977 and other tubular fluorescent lamps for high frequency operation.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
2418 (Part 2) : 1977	Tubular fluorescent lamps for general lighting service: Part 2 Standard lamp data sheets (*first revision*)
10322 (Part 1) : 1982	Luminaires: Part 1 General requirements
11000 (Part 2/ Sec 1) : 1984	Fire hazard testing: Part 2 Test methods, Section 1 Glow-wire test and guidance
11000 (Part 2/ Sec 2) : 1984	Fire hazard testing: Part 2 Test methods, Section 2 Needleflame test
12063 : 1987	Classification of degrees of protection provided by enclosures of electrical equipment

3 DEFINITIONS

3.0 For the purpose of this standard the following definitions shall apply.

3.1 Ballast

A unit inserted between the supply and one or more fluorescent lamps which serve mainly to limit the current of the lamp(s) to the required value. The unit may consist of one or more separate components.

It may also include means for transforming the supply voltage and arrangements which help to provide starting voltage and preheat current, prevent cold starting, reduce stroboscopic effects, correct the power factor and/or suppress radio interference.

3.1.1 *Independent Ballast*

A ballast which may be mounted separately outside the luminaire and without any additional enclosure. This may consist of a built-in-ballast housed in a suitable enclosure which provides all the necessary protection according to its marking.

3.1.2 *Built-In-Ballast*

A ballast exclusively designed to be built into a luminaire, a box, an enclosure or the like.

3.1.3 *Integral Ballast*

A ballast which forms a non-replaceable part of a luminaire and which may not be tested separately from the luminaire.

3.1.4 *ac Supplied Electronic Ballast*

A mains supplied ac to ac invertor including elements for starting and operating one or more tubular fluorescent lamps, generally at high frequency.

3.2 Supply Voltage

The voltage applied to the complete circuit of lamp(s) and ballast.

3.3 Working Voltage

The highest rms voltage which may occur across any insulation, transients being neglected, in open-circuit conditions or during lamp operation, when the ballast is operated at its rated voltage.

3.4 Supply Current

The current supplied to the complete circuit of lamp(s) and ballast.

3.5 Live Part

A conductive part which may cause an electric shock in normal use. The test to determine whether or not a conductive part is a live part which may cause an electric shock is given in Annex A. Nevertheless, the neutral conductor shall be regarded as a live part.

3.6 Rectifying Effect

The effect which may occur at the end of lamp life when one cathode is broken or has insufficient electron emission resulting in the arc current being constantly unequal in consecutive half cycles.

3.7 Type Test

A test or series of tests made on a type-test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant specification.

3.8 Type Test Sample

A sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of a type test.

3.9 Rated Maximum Operating Temperature of a Ballast Case—Symbol t_c

The highest permissible temperature which may occur on the outer surface (at the indicated place if marked) of the ballast under normal operating conditions and at the rated voltage or the maximum of the rated voltage range.

4 GENERAL REQUIREMENTS

4.1 Ballasts shall be so designed and constructed that in normal use they operate without danger to the user or surroundings.

4.1.1 Compliance for ballasts and other elements is checked by carrying out all the tests specified.

4.1.1.1 In addition, the outer case of independent ballasts shall comply with the requirements of IS 10322 (Part 1) : 1982, including the classification and marking requirements of that standard. For the thermal test, independent ballasts shall be mounted in a test corner consisting of three dull-black painted boards 15 to 25 mm thick and arranged so as to imitate two walls and the ceiling of a room. The ballast is secured to the ceiling as close as possible to the walls, the ceiling extending atleast 250 mm beyond the other side of the ballast.

5 GENERAL NOTES ON TESTS

5.1 Unless otherwise specified the tests are carried out at an ambient temperature between 10°C and 30°C.

5.2 The tests are carried out in the order of the clauses unless otherwise specified.

5.3 The type test is carried out on one type test sample.

6 CLASSIFICATION

6.1 Ballasts are classified according to the mode of installation:

a) Independent ballasts;

b) Ballasts for building-in (built-in-ballasts); and

c) Integral ballasts.

7 MARKING

7.1 Marking of a Ballast

The ballast shall be clearly marked as follows:

a) Indication of the source of manufacture or responsible vendor;

b) Model number or type reference of the manufacturer;

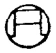
c) Wiring diagram indicating the position of terminals. In the case of ballasts not having terminals, a clear indication shall be given on the wiring diagram of the significance of the code used for the connecting wires;

d) The correlation between interchangeable parts of an electronic ballast and the electronic ballast itself shall be marked unambiguously by legends on the electronic ballast or specified in the manufacturer's catalogue;

e) Rated supply voltage (or voltages, if there are several), supply frequency and supply current(s); the supply current may be given in the manufacturer's literature;

f) Symbol for earthing (*see* **9**);

g) The value of t_c — If t_c relates to a certain place on the ballast, this place shall be indicated or specified in the manufacturer's catalogue; and

h) Symbol for independent ballast  ; if applicable.

7.1.1 The ac ballasts may also be marked with the Standard Mark, details for which may be obtained from the Bureau of Indian Standards.

7.2 Information to be provided, as applicable;

In addition to the above mandatory markings, the following information, if applicable, shall be given either on the ballast, or be made available in the manufacturer's catalogue or the like:

a) Rated wattage or designation as indicated on the lamp data sheet of the types of lamp for which the ballast is designed. If the ballast may be used with more than one lamp, the number and wattage of each lamp shall be indicated;

b) A declaration of the ballast does not rely upon the luminaire enclosure for protection against accidental contact; and

c) A declaration of the cross-section of conductor(s) for which the terminals, if any, are suitable.

7.3 Test for Marking

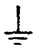
The durability and legibility of the marking shall be checked by trying to remove it by rubbing lightly for 15 s with a piece of cloth soaked with water, and after drying, for a further 15 s with a piece of cloth soaked with hexane. The marking shall be legible after the test.

8 TERMINALS

8.1 Screw terminals shall comply with **14** of IS 10322 (Part 1) : 1982. Screwless terminals shall comply with **15** of IS 10322 (Part 1) : 1982.

9 PROVISIONS FOR EARTHING

9.1 Graphical symbol : Protective earth (ground).



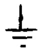
9.1.1 Any earthing terminal shall comply with the requirements of **8**. The electrical connection shall be adequately locked against loosening and it shall not be possible to loosen the electrical connection without the use of a tool. For screwless terminals, it shall not be possible to loosen the clamping means unintentionally.

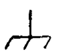
9.1.2 Earthing of ballasts *via* the means of fixing the ballasts to earthed metal is permitted. However, if a ballast has an earthing terminal, this terminal shall only be used for earthing the ballast.

9.1.3 All parts of an earth terminal shall be such as to minimize the danger of electrolytic corrosion resulting from contact with the earth conductor or any other metal in contact with them. The screw or the other parts of the earthing terminal shall be made of brass or other metal no less resistant to corrosion, or material with a non-rusting surface and at least one of the contact surfaces shall be bare metal.

9.1.4 Compliance is checked by inspection by the tests as per clause **8.1**.

9.2 Graphical symbol:

a) Functional earth (ground)  , and

b) Frame or chassis 

A functional earthing terminal denotes a terminal to which are connected parts which may necessarily be connected to earth for reasons other than safety.

NOTE — In some instances, starting aids adjacent to the lamp(s) are connected to one of the output terminals but need not be connected to the earth on the supply side.

10 CREEPAGE DISTANCES AND CLEARANCES

10.1 Creepage distances and clearances shall be not less than the values given in Table 1, unless otherwise specified in **16**.

10.1.1 Ballasts where the components are so enclosed, for example, by encapsulation in a self-hardening compound bonded to the relevant surfaces that no clearances in air exist, are not checked.

10.1.2 Printed boards are exempt from the requirements of **10** because they are tested according to **16**.

10.1.3 The contribution to the creepage distance of any groove less than 1 mm wide shall be limited to its width.

10.1.4 Any air gap less than 1 mm shall be ignored in computing the total air path.

NOTE — Creepage distances are measured along with the external surface of the insulating material.

10.1.5 A metallic enclosure shall have an insulating lining (requirements are under consideration), if in the absence of such a lining the creepage distance or clearance between the live parts and the enclosure is smaller than the value specified above.

Table 1 Creepage Distances and Clearances in Air

Working Voltage (rms) (1)	Up to and Including 34 V (2)	Above 34 V Up to and Including 250 V (3)	Above 250 V Up to and Including 500 V (4)	Above 500 V Up to and Including 750 V (5)	Above 750 V Up to and Including 1 000 V (6)
Creepage distance and clearance:					
a) Between live parts of different polarity	2	3 (2)	4 (2)	5 (3)	6 (4)
b) Between live parts and acceptable metal parts which are permanently fixed to the ballast including screws or devices for fixing covers or fixing the ballast to its supports clearance	2	4 (2)	5 (3)	6 (4)	6 (4)
c) Between live parts and a flat supporting surface or a loose metal cover, if any, if the construction does not ensure that the values under 2 above are maintained under the most unfavourable circumstances	2	6	8	10	10

NOTE — The values between brackets apply to creepage distances and clearances where the surface area is not liable to contamination by dust or moisture.

11 PROTECTION AGAINST ACCIDENTAL CONTACT WITH LIVE PARTS

11.1 Ballasts, which do not rely upon the luminaire enclosure for protection against electric shock (*see* **7.2** b) when installed as in normal use, shall be sufficiently protected against accidental contact with live parts as specified in Annex A.

11.1.1 Lacquer or enamel is not deemed to be adequate protection or insulation for the purpose of this requirement.

11.1.2 Parts providing protection against accidental contact shall have adequate mechanical strength and shall not work loose in normal use. It shall not be possible to remove them without the aid of a tool.

11.1.3 Compliance is checked by inspection and, if necessary, by a test with the standard test finger according to IS 12063 : 1987. This finger is applied in every position, if necessary, with a force of not more than 10 N, an electrical indicator being used to show contact with live parts. It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

11.2 Ballasts incorporating capacitors of total capacitance exceeding 0·5 μF shall be constructed so that the voltage at the ballast terminations does not exceed 50 V, 1 min after disconnection of the ballast from a source of supply at rated voltage.

12 PROTECTION AGAINST ELECTRIC SHOCK

12.1 The open circuit voltage at the output terminals shall be measured with and without dummy cathode resistors inserted. It shall, at no time exceed the value of 1 500 V (peak).

12.1.1 For ballasts whose output terminals are to be connected to 250 V rating components, the voltage between any output terminal and neutral or earth shall decrease within 5 s after switching on or beginning of the starting process to a value less than 700 V (peak), both under normal and abnormal conditions. In cases where the components have a higher rated voltage, the voltage.limit (peak) is *under consideration.*

12.1.2 The requirements do not apply to ballasts whose output terminals are floated by the incorporated insulating transformer.

13 MOISTURE RESISTANCE AND INSULATION

13.1 The ballast shall be moisture resistant. It shall not show any appreciable damage, after being subjected to the following test.

The ballast shall be conditioned for 48 h in an enclosure containing air with a relative humidity maintained between 91 percent and 95 percent. The temperature of the air at all places where samples can be located is maintained wtihin ±1°C of any convenient value *t* between 20°C and 30°C.

Before being placed into the enclosure, the sample is brought to a temperature between *t* and (*t*+4)°C.

Insulation shall be adequate between the input and output terminals bonded together and all exposed metal parts.

Before the insulation test, visible drops of water, if any, shall be removed by means of blotting paper.

Immediately after the moisture test(s), the insulation resistance shall be measured with a dc voltage of approximately 500 V, 1 min after the application of the voltage. Ballasts having an insulation cover or envelope shall be wrapped with metal foil.

The insulation resistance shall be not less than 2 MΩ.

In the case of ballasts having an internal connection between one or more output terminals and the earth terminal, such a connection shall be removed during this test.

14 ELECTRIC STRENGTH

14.1 Immediately after the measurement of the insulation resistance, the ballast shall withstand an electric strength test for 1 minute applied between the parts specified in **13.**

14.1.1 The test voltage of substantially sine-wave form, having a frequency of 50 Hz shall correspond to the values in Table 2. Initially not more than half the voltage specified is applied the voltage is than raised rapidly to the prescribed value.

Table 2 Electric Strength Test Voltage

Working Voltage (*U*)	Test Voltage (*V*)
Up to and including 42 V	500
Above 42 V up to and including 1 000 V	2 *U*+1 000

14.1.2 No flashover or breakdown shall occur during the test. The high-voltage transformer used for the test shall be so designed that when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA.

14.1.3 The overcurrent relay shall not trip when the output current is less than 100 mA. Care shall be taken that the rms value of the test voltage is measured within ±3 percent. Care shall be taken that the metal foil mentioned in **13** is so placed that no flashover occurs at the edges of the insulation. Glow discharges without drop in voltage are neglected.

15 ABNORMAL CONDITIONS

15.1 The ballast shall not impair safety when operated under abnormal conditions at any voltage between 90 percent and 110 percent of the rated supply voltage.

15.2 Compliance* is checked by the following test:

Each of the following conditions shall be applied with the ballast operating according to the manufacturer's instruction (including heat sinks, if specified) for 1 h:

a) The lamp or one of the lamps is not inserted;

b) The lamp does not start because one of the cathodes is broken;

c) The lamp does not start although the cathode circuits are intact (de-activated effect);

d) The lamp operates, but one of the cathodes is de-activated or broken (rectifying effect); and

e) Short-circuit of the starter switch, if any.

For the test simulating operation with a de-activated lamp, a resistor shall be connected in place of each lamp cathode. The resistor value shall be derived from the value of the normal running current of the lamp prescribed in the relevant lamp data sheet of IS 2418 (Part 2) : 1977, and substituted in the following equation:

$$R = \frac{11{\cdot}0}{2{\cdot}1 I_n}\,\Omega$$

where

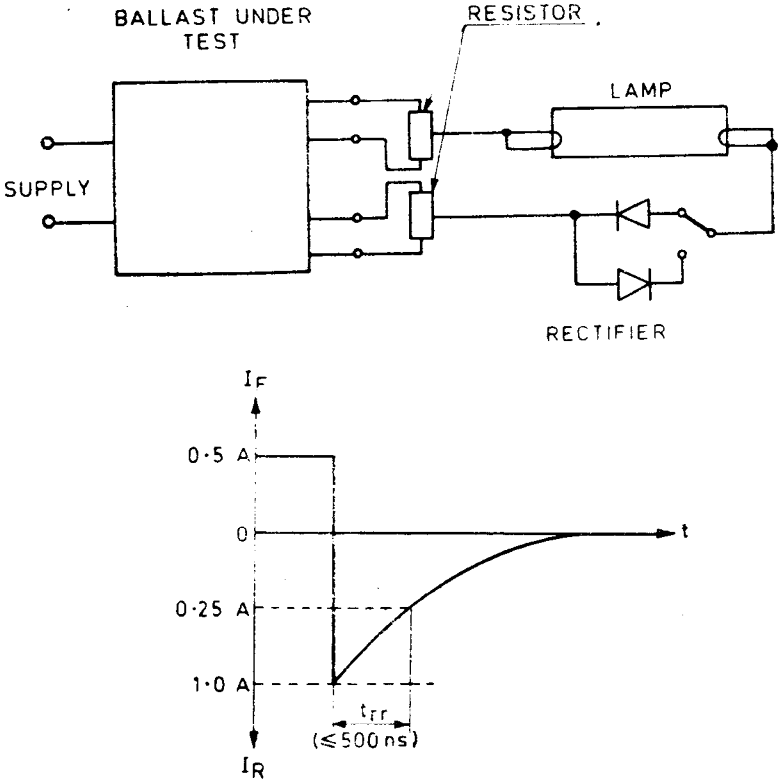
I_n = nominal running current of the lamp.

For lamps, not covered by IS 2418 (Part 2) : 1977, the value declared by the lamp manufacturer shall be used.

When testing electronic ballasts for the rectifying effect, the circuit shown in Fig. 1, shall be used.

The lamp shall be connected to the midpoints of the appropriate equivalent resistors. The rectifier polarity shall be chosen so as to give the most unfavourable conditions. If necessary, the lamp shall be started using a suitable starting device.

During and at the end of the tests specified under items (a) to (e), the ballast shall show no defect impairing safety, nor shall any smoke be produced.



The following types of diodes (three diodes) in series are recommended as a suitable rectifier.

RGP 30M BYM 96E BYV 16

The rectifier characteristics shall be:

— Peak inverse voltage	U_{RRM}	$\geqslant$	3 000 V
— Reverse leakage current	I_R	$\leqslant$	10 μ A
— Forward current	I_F	$\geqslant$	3 times nominal lamp running current
— Transitition time (*Max* frequency 150 kHz)	t_{rr}	$\leqslant$	500 ns (measured with I_F = 0·5 A and I_R = 1 A at I_R = 0·25 A)

FIG. 1 CIRCUIT FOR TESTING RECTIFYING EFFECT

16 FAULT CONDITIONS

16.0 A ballast shall be so designed that when operated under fault conditions, there shall be no emission of flames or molten metal nor produce flammable gases and the protection against accidental contact in accordance with **11.1** shall not be impaired.

In the case an electronic ballast provided with the marking ▽PA or ▽PB the ballast case temperature at any place shall not exceed the marked value.

NOTE — Ballasts and filter coils, if any, without such marking, are checked together with the luminaire in accordance with the respective standard on luminaire.

Operation under fault conditions denotes that each of the conditions specified in **16.1** to **16.4** is applied in turn and, associated with it, those other fault conditions which are a logical consequence thereof, with the provision that only one component at a time should be subjected to fault condition. Examination of the apparatus and its circuit diagram shall generally show the fault conditions which should be applied. These are applied in sequence in the order which is most convenient.

Totally enclosed ballasts are not opened for examination nor for the application of internal fault conditions, however, in case of doubt, in conjunction with the examination of the circuit diagram, either the output terminals shall be short-circuited in agreement with the manufacturer, a specially prepared ballast shall be submitted for testing.

A device is considered to be totally enclosed if the components are so enclosed, for example, by encapsulation in a self-hardening compound bonded to the relevant surfaces, that no clearances in air exist.

Components in which according to the manufacturer's specification a short-circuit does not occur or which eliminates a short-circuit, shall not be bridged nor shall components in which according to the manufacturer's specification an open-circuit does not occur, be interrupted.

The manufacturer shall show evidence that the components be hard in the foreseen way, for example, by showing compliance with a relevant specification.

Capacitor, resistors or inductors not complying with a relevant standard shall be short-circuited or disconnected, whichever is most unfavourable.

16.1 Short-circuit across creepage distances and clearance in air if they are less than the values specified in **10**, taking into account, however, any reduction allowed in **16.1** or **16.4**.

NOTE — Creepage distances and clearances below the values of 10 are not allowed between live parts and accessible metal parts.

Between conductors, protected from surge energy from the supply, for example, by choke winding or capacitor, which are on a printed board complying with the pull-off and peel strength requirements specified in respective standard on printed circuits, the creepage requirements are modified. The dimensions of Table 1 are replaced by the values calculated from the equation:

$$\text{Log } d = 0{\cdot}78 \log \frac{V}{300}, \text{ with a minimum of } 0{\cdot}5 \text{ mm}$$

where

d = distance in mm,

V = peak of value of the voltage in volts.

These distances may be determined by reference to Fig. 2.

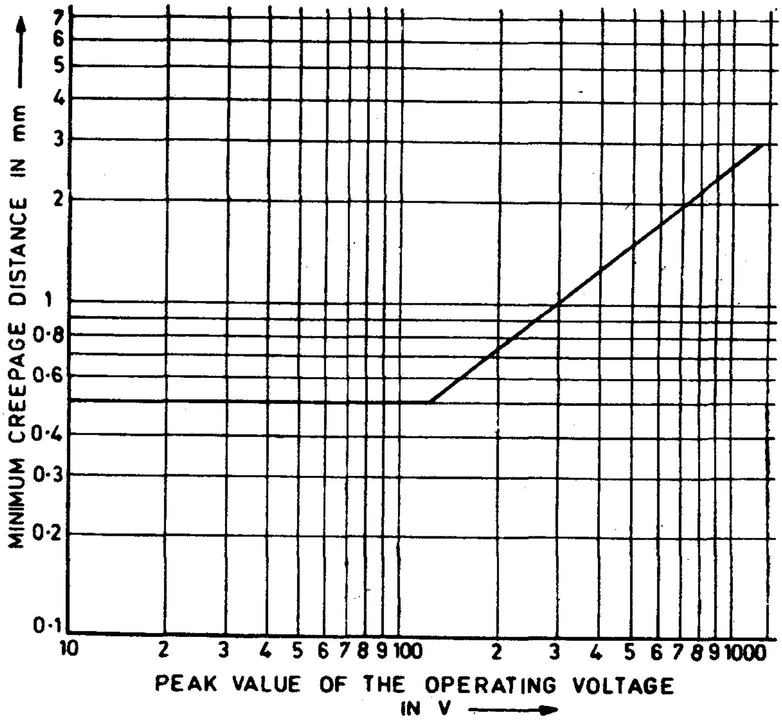


Fig. 2 Creepage Distances Between Conductors on Printed Boards not Being Conductively Connected to the Supply Mains

NOTE — Coverings of lacquer or the like on printed boards are ignored when calculating the distances.

16.2 Short-Circuit Across or, if Applicable, Interruption of Semi-conductor Devices

16.2.1 Only one component at a time, should be short-circuited (or interrupted).

16.3 Short-Circuit Across Insulation Consisting of Covering of Lacquer, Enamel or Textile

16.3.1 Such coverings are ignored in assessing the creepage distances and clearances in air specified in Table 1. However, if enamel forms the insulation of a wire and withstands the voltage test prescribed in respective Indian standards on winding wires, it is considered as contributing 1 mm to those creepage distances and clearances in air.

16.3.2 This does not imply a need to short-circuit the insulation between turns of coils, insulating sleeves or tubing.

16.4 Short-circuit across electrolytic capacitors.

16.4.1 Compliance is checked by operating the ballast at any .voltage between 0·9 and 1·1 times rated supply voltage with the lamp connected and with the ballast case at t_c; then each of the fault conditions outlined in **16.1** to **16.4** inclusive shall be applied in turn.

16.4.2 The test shall be continued until stable conditions are obtained and the ballast case temperature is measured. When making the tests of **16.1** to **16.4** inclusive components such as resistors, capacitors, fuses, etc, may fail. It is permitted to replace the components so as to continue the test.

16.4.3 After the test when the ballasts has returned to ambient temperature, the insulation resistance measured at appoximately 500 V dc, shall not be less than 1 MΩ.

To check whether gases liberated from component parts are flammable or not, a test with a high frequency spark generator is made.

To check whether accessible parts have become live, the test according to Annex A shall be made.

17 CURRENT-CARRYING PARTS AND CONNECTIONS

17.1 Electrical connections shall be so designed that contact pressure is not transmitted through insulating materials other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or deformation of the insulating material.

17.1.1 Compliance is checked by inspection.

17.2 Spaced threaded screws shall not be used for the connection of current-carrying parts unless they clamp these parts directly in contact with each other and are provided with a suitable means of locking.

17.2.1 Thread-cutting screws may be used for the interconnection of current-carrying parts which are not of metal which is soft or liable to creep, such as zinc or aluminium. Spaced threaded screws may be used to provide protective earth continuity, provided it is not necessary to disturb the connection in normal use and at least two screws are used for each connection.

17.2.2 Compliance is checked by inspection.

17.3 Screws and rivets which serve as electrical as well as mechanical connection shall be locked against loosening. Spring washers may provide satisfactory locking.

17.3.1 For rivets, a non-circular shank or an appropriate notch may be sufficient.

17.3.2 Sealing compound which softens on heating provides satisfactory locking for screw connection not subject to torsion in normal use.

17.3.3 Compliance is checked by inspection and manual test.

17.4 Current-carrying parts shall be of copper, an alloy containing at least 50 percent of copper or material having characteristics at least equivalent. This requirement does not apply to screws which do not essentially carry current such as terminal screws.

17.4.1 Compliance is checked by inspection and, if necessary, by chemical analysis.

17.4.2 Special care shall be taken with regard to corrosion and mechanical properties.

17.5 Screws and mechanical connections, the failure of which might cause the ballast to become unsafe, shall withstand the mechanical stresses occurring in normal use.

17.5.1 Screws transmitting contact pressure which have a normal diameter less than 3 mm shall screw in metal.

17.5.2 Compliance is checked by inspection and for screws and nuts transmitting contact pressure by the following tests.

17.5.2.1 The screws or nuts are tightened or loosened:

a) 10 times for screws in engagement with a thread of insulating material; and

b) 5 times for nuts or other screws.

17.5.3 Screws in engagement with a thread of insulating material are completely removed and reinserted each time.

17.5.4 When testing terminal screws and nuts, a solid conductor of appropriate cross-section specified in **8** is placed in the terminal. The test is made by means of a suitable test screw driver or spanner applying a torque as shown in

Table 3. Column 1 applies to screws without heads if the screw, when tightened, does not protrude from the hole. Column 2 applies to other screws and nuts.

Table 3 Torque Tests on Screws and Nuts

(*Clause* 17.5)

Nominal Diameter Screw (mm)	Torque (Nm)	
	1	2
Up to and including 2·8	0·2	0·4
Over 2·8 up to and including 3·0	0·25	0·5
Over 3·0 up to and including 3·2	0·3	0·6
Over 3·2 up to and including 3·6	0·4	0·8
Over 3·6 up to and including 4·1	0·7	1·2
Over 4·1 up to and including 4·7	0·8	1·8
Over 4·7 up to and including 5·3	0·8	2·0
Over 5·3 up to and including 6·0	—	2·5

17.5.5 The conductor is moved each time the screw or nut is loosened.

17.5.6 During the test, no damage impairing the future use of the screwed connection shall occur.

17.5.7 Screws which may be operated when connections are made to the ballast include for example, terminal screws, screws for fixing covers when they have to be loosend to open the ballast, etc. Conduit thread connections and screws to fasten ballasts to their supports are excluded. The shape of the blade of the test screw-driver shall match the slot of the screw to be tested. The screw shall not be tightened in jerks. Nuts are tested in a similar manner. Damage to covers is neglected.

18 RESISTANCE TO HEAT AND FIRE

18.1 Parts of insulating material retaining live parts in position shall be sufficiently resistant to heat.

18.1.1 For materials other than ceramic, compliance shall be checked by subjecting the parts to the ball pressure test according to respective Indian Standards on private boards.

18.2 External parts of insulating material providing protection against electric shock and parts of insulating retaining live parts in position shall be sufficiently resistant to fire.

18.2.1 For materials other than ceramic, compliance is checked by the test of **18.3** and **18.4**. However, printed boards are not tested as above, but shall be tested according to respective Indian Standards on printed boards.

18.3 External parts of insulating material providing protection against electric shock shall be subjected to the glow-wire test in accordance with IS 11000 (Part 2/Sec 1) : 1984, subject to the following:

a) The test sample shall be one specimen,

b) The test specimen shall be a complete ballast, and

c) The temperature of the tip of the glow-wire shall be 650°C.

18.4 Parts of insulating material retaining live parts in position shall be subjected to the needle flame test in accordance with IS 11000 (Part 2/ Sec 2) : 1984, subject to the following:

a) The test sample shall be one specimen;

b) The test specimen shall be a complete ballast;

If it is necessary to take away parts of the ballast to perform the test, care shall be taken to ensure that the test conditions are not significantly different from those occurring in normal use;

c) The test flame shall be applied to the centre of the surface to be tested;

d) The duration of application shall be 10 s; and

e) Any self-sustaining flame shall extinguish within 30 s removal of the gas flame and any flaming drops shall not ignite a piece of tissue paper, consisting of five layers, spread out horizontally 200 mm below the test specimen.

19 RESISTANCE TO CORROSION

19.1 Ferrous parts, the rusting of which may endanger the safety of the ballast, shall be adequately rust-protected.

19.1.1 Compliance is checked by inspection.

19.1.2 All grease shall be removed from the parts to be tested by immersion in a suitable degreasing agent for 10 minutes.

19.1.3 The parts shall then be immersed for 10 minutes in 10 percent solution of ammonium chloride in water at a temperature of 20 ± 5°C.

19.1.4 Without drying, but after shaking off any drops of water, the parts shall be placed for 10 minutes in a box containing air saturated with moisture at a temperature of 20 ± 5°C.

19.1.5 After the parts have bee dried for 10 minutes in a heating cabinet at a temperature of 100 ± 5°C, their surfaces shall show no sign of rust. Traces of rust on any sharp edge and yellowish film removable by rubbing are ignored.

19.1.6 Protection by varnish is deemed to be adequate for the outer surface.

ANNEX A

(*Clauses* 3.5, 11.1 *and* 16.4.3)

TEST TO ESTABLISH WHETHER A CONDUCTIVE PART IS A LIVE PART WHICH MAY CAUSE AN ELECTRIC SHOCK

In order to determine whether a conductive part is a live part which may cause an electric shock, the ballast is operated at design voltage and nominal frequency and the following tests are conducted:

a) The current flowing between the part concerned and earth is measured, the measuring circuit having an non-inductive resistance of 2 000 ± 50Ω. The part concerned is a live part if a current of more than 0·7 mA (peak) or 2 mA dc is measured.

   For frequencies above 1 kHz, the limit of 0·7 mA is multiplied by the value of the frequency in kHz, but shall not exceed 70 mA (peak); and

b) The voltage between the part concerned and any accessible part is measured, the measuring circuit having a non-inductive resistance of 50 000 Ω. The part concerned is a live part if a voltage of more than 34 V (peak) is measured.

For the above test, one pole of the test supply shall be at earth potential.

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TO
IS 13021 (Part 1) : 1991 ac SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS — SPECIFICATION

PART 1 GENERAL AND SAFETY REQUIREMENTS

(*Page* 1, *clause* **2.1**) — Insert the following at the end:

‘*IS No.*	*Title*
2824:1975	Method of determining the comparative tracking index of solid insulating materials under moist conditions (*first revision*)
10322 (Part 4) :1984	Luminaires: Part 4 Methods of test
10322 (Part 3) :1984	Luminaires: Part 3 Screw and screwless terminals
13021 (Part 2) :1991	ac supplied electronic ballasts for tubular fluorescent lamps: Part 2 Performance requirements’

(*Page* 1, *clause* **3.1.4**) — Insert the following new sub-clauses:

‘**3.1.5** *Controllable Ballasts*

Lamps power (light output) of the electronic ballasts is controlled between the minimum value (or off) and the maximum value by the signal on the control input of the ballast.

3.1.6 *Maximum value of lamps power (of a controllable ballast)*

Lamp power (light output) which complies with **8.1** of IS 13021 (Part 2) :1991 unless otherwise declared by the manufacturer or responsible vendor.

3.1.7 *Maximum value lamp power (of a controllable ballast)*

Lowest percentage of the lamp power defined in **3.1.6** declared by the manufacturer or responsible vendor.’

(*Page* 2, *clause* **3.9**) — Insert the following new sub-clauses:

'3.10 Control Terminals

Connections to the electronic ballast which are used to apply a control signal for changing the light output. The power supply terminals can also act as control terminals.

3.11 Control Signal

Signal, which may be an ac or dc voltage, and by which by analog, digital or other means may be moduled to convey the necessary information to the ballast for the purpose of changing the light output.'

(*Page* 2, *clause* **7.1**) — Insert the following new item (j):

'j) For controllable ballasts, the control terminals shall be identified.'

(*Page* 3, *clause* **8.1**) — Substitute the following for the existing entries:

'**8.1** Screw terminals shall comply with **3** and **4** of IS 10322 (Part 3) : 1984. The screwless terminals shall comply with **5** to **8** of IS 10322 (Part 3) : 1984.'

(*Page* 3, *clause* **9.1.4**) — Insert the following new sub-clause:

'**9.1.5** Conductors for protective earthing provided by tracks or printed circuit boards shall be tested as follows:

A current from an ac source of 25 A is passed for 1 min between the earthing terminal or earthing contact via the track on the printed board and each of the accessible metal parts in turn.

After the test the voltage drop between the earthing terminal or earthing contact and the accessible metal point shall be measured and the resistance calculated from the current and the voltage drop. In no case shall the resistance exceed 0.5 .'

(*Page* 3, *clause* **10**) — Substitute the following for the existing entries against the entire clause:

'**10.1** Creepage distances and clearances shall not be less than the value given in Tables 1 A and 1 B, as appropriate, unless otherwise specified in **16**.

10.1.1 The contribution to the creepage distance of any groove less than 1 mm wide shall be limited to its width.

Any air gap of less than 1 mm shall be ignored in computing the total air path.

NOTE — Creepage distances are distances in air, measured along with the surface of insulation.

10.1.2 A metal enclosure shall have an insulating lining, if in the absence of such a lining, the creepage distance and clearance between live parts and the enclosure would be smaller than the value prescribed in Tables 1A and 1B.

10.1.3 Ballasts, where the components are so encapsulated in a self-hardening compound bonded to the relevant surfaces that no clearance exists, are not checked.

10.1.4 Printed boards are exempt from the requirement of this clause because they are tested according to 16.

Table 1 A Minimum Distances for ac (50 Hz) Sinusoidal Voltages

Minimum Distances (mm)↓ RMS working voltage not exceeding (V)→	50	150	250	500	750	1000
1. Between live parts of different polarity and						
2. Between live parts and accessible metal parts which are permanently fixed to the ballast including screws or devices for fixing covers or fixing the ballast to its support						
—Creepage distance insulating insulation PTI ≥ 600	0.6	1.4	1.7	3	4	5.5
<600	1.2	1.6	2.5	5	8	10
—Clearances	0.2	1.4	1.7	3	4	5.5
3. Between live parts and a flat supporting surface or a loose metal cover, if any, if the construction does not ensure that the values under 2 above are maintained under the most unfavourable circumstances —clearances	2	3.2	3.6	4.8	6	8

NOTES

1. PTI (Proof Tracking Index) in accordance with IS 2824:1975.

2. In the case of creepage distances to parts not energised or not intended to be earthed where tracking cannot occur, the value specified for material with PTI 600 ô apply for all materials (inspite of the real PTI).

For creepage distances subjected to working voltages of less than 60 s duration the values specified for material with PTI ô 600 apply for all materials.

3. For creepage distances not liable to contamination by dust or moisture the values specified for material with PTI ô 600 apply (independent of the real PTI).

Table 1 B Minimum Distances for Non-Sinusoidal Pulse Voltages

Minimum Distance (mm)↓	Rated Pulse Voltage (Peak)→	2.0	2.5	3.0	4.0	5.0	6.0	8.0
Clearances		1.0	1.5	2	3	4	5.5	8

10.1.5 For distances subjected to both sinusoidal voltage as well as non-sinusoidal pulses, the minimum required distance shall not be less than the highest value indicated in either table.

Creepage distances shall not be less than the required .clearance.'

(*Page* 4 , *clause* **12.1.2**) — Insert the following new sub-clause:

'**12.2** For controllable electronic ballasts, the control input shall be isolated from the main circuits by an insulation at least equal to basic insulation.

NOTES

1. This requirement does not apply to those ballasts where control signals are injected via the supply terminals.

2. If SELV in to be used, then double or reinforced insulation is required.'

(*Page* 4, *clause* **13.1**, *para* 5) — Substitute the following for the existing entries:

'Insulation shall be adequate between the input and output terminals bonded together, and all exposed metal parts and the control terminals, where relevant.'

(ETD 23)

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